Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia 15N Uptake, Utqiagvik (Barrow), Alaska, 2018

NGEE Arctic Record_id: NGA258

Summary:

This dataset consists of atom percentage of 15N in excess of natural abundance after injection and incubation, uptake rate of 15N during incubation period and percent recovery of 15N labeled ammonia in *A. latifolia* tissues in vegetation warming experiment enclosures and paired control plots located on the BEO, Utqiaġvik, Alaska.

Vegetation warming chambers (Zero Power) were deployed on the Barrow Environmental Observatory (BEO), Utqiaġvik, Alaska. These chambers (Figure 1) consistently elevated air temperatures by approximately 4°C using a self-venting system described by Lewin et al (2017). Five chambers were deployed from June 17, 2018 to September 24, 2018 on the BEO within a 1 km2 area centered on 71.275N, -156.641W. Each chamber was co-located with an ambient plot where temperatures were not manipulated on patches of tundra containing the target species *Arctagrostis latifolia*. An intensive field campaign in late July investigated the impact of warming had on *A. latifolia* biomass, chemistry, and uptake of 15N labeled ammonia that was injected into the surface soils for one week. Initial measurements were taken on July 21, 2018. Harvest occurred on July 27, 2018. Water-extractable nutrients in soils were measured in July following harvests of *A. latifolia* plants and underlying soils. Availability of ammonia, nitrate, and phosphate throughout the growing season was measured by extracting nutrients bound to anion and cation binding resins deployed from July through September. Environmental variables (thaw depth, surface soil temperatures, surface soil moisture) were measured. Leaf traits and root traits of *A. latifolia* were also measured.

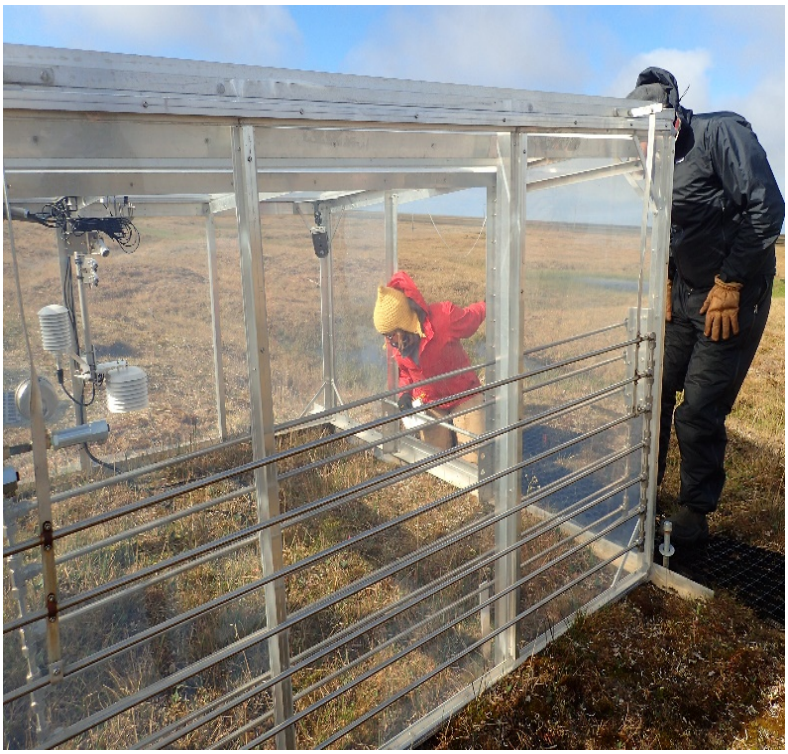

Figure 1. Zero Power Warming chambers

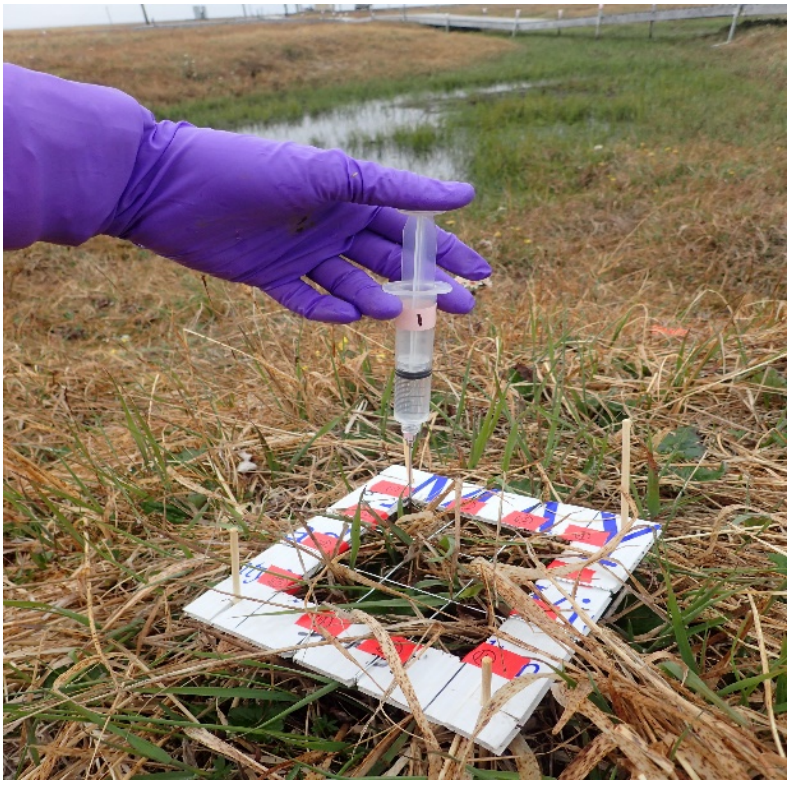

Figure 2. Injection of 15N label ammonia

Please use this citation to reference the data.

Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia 15N Uptake, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. Dataset accessed on [INSERT_DATE] at https://doi.org/10.5440/1784751.

List of 15N Uptake Experiment Datasets:

Here is the complete list of **15N Uptake Experiment** datasets containing supplemental information and environmental observations, *A.latifolia* (ARCLAT) leaf traits, root traits, 15N uptake, soil inorganic N and P, and soil extractable N and P.

[Additional **Vegetation Warming Experiment** related datasets are listed following References.]

NGA246	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia Canopy Traits, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784759
NGA247	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Environmental Observations and Thaw Depth, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784757
NGA250	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia Biomass and Chemistry, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784750
NGA257	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia Root Traits, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784749

NGA258	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Arctagrostis latifolia 15N Uptake, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784751
NGA259	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Inorganic Nitrogen and Phosphorus on Resins, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784752
NGA260	Verity Salmon, Joanne Childs, Colleen Iversen, Breann Spencer, Alistair Rogers, Kim Ely, Shawn Serbin. 2021. **Vegetation Warming Experiment: 15N Uptake Experiment Water-Extractable Soil Nutrients, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1784755

Data Characteristics

Location:

Vegetation warming experiment chambers and paired ambient control plots were located within a 1 km2 area centered around this general location (71.275N, -156.641W) on the Barrow Environmental Observatory, Utqiagvik (Barrow), AK, USA. Individual chamber and ambient plot locations and elevations measured by dGPS are provided in Rogers et al. (2019).

Temporal Range: Harvest occurred on 2018-07-25

This dataset is comprised of one comma-separated (*.csv) data file consisting of atom percentage in excess (APE), 15N uptake rate and 15N recovery of NH4 label in *A. latifolia* tissue and one user guidance document (*.pdf).

Data Dictionary

Data Files: 2018_ZPW_ORNL_APE_Uptake.csv

column_name	units/format	Description
region *		Values: North Slope
locale *		Values: Utqiagvik
plot		Values represent plot ID (11 through 15 in 2018 deployment of ZPW chambers)
treatment		Values: AMB = Ambient temperature plot ZPW = Warmed plot
REP		Values indicate replicates (A or B) within a plot or absence of replicate (NA)
harvest _type		Values indicate replicate from 15N enriched harvested type or paired natural abundance type 15N = enriched harvest NAT = paired natural abundance
sample_type		Values: block = approximately 8 cm depth organic layer sample collected with a knife core = 5 cm depth increment of soil core spanning bottom of organic layer to frozen ground
AboveOrBelow		Values: Above = above ground tissue Below = below ground tissue
Tissue		Values indicate ARC LAT tissue type
APE_percent	%	atom percentage 15N in excess of natural abundance 15N
Nuptake_ugNperm2perhr	ug/m2/hr	15N uptake rate during incubation period
15NRecoveryOfAdded_percent	%	percent added 15N recovered by tissue

* Values for these location fields have been standardized for NGEE Arctic and are required fields for all data dictionaries.

Example Data Records:

2018_ZPW_ORNL_APE_Uptake.csv

region,locale,plot,treatment,REP,harvest_type,sample_type,AboveOrBelow,Tissue,APE_percent,Nuptake_ugNperm2perhr,15NRecoveryOfAdded_percent
North Slope,Utqtiagvik,11,AMB,A,15N,block,Above,Blade,0.028,1.318,0.147
North Slope,Utqtiagvik,11,AMB,A,15N,block,Above,Inflorescence,0,0,0
North Slope,Utqtiagvik,11,AMB,A,15N,block,Above,NewTiller,0.007,0.031,0.003

Data Acquisition Materials and Methods

Warming treatment was implemented in Utqiaġvik, Alaska on the Northern coastal plain using Zero Power Warming (ZPW) chambers that elevate air temperatures by approximately 4°C. Details on design and impact of the warming chambers are documented in Lewin and others (2017).

At one location within each chambered plot and co-located ambient plot, 9 x 9 cm areas of *A. latifolia* were harvested. A serrated knife was used to cut the organic layer (approximately 8 cm in depth) into a square block. Organic soil and intact vegetation were then removed together. To sample roots and soils beneath the organic layer, a soil core was collected from within the footprint of the harvested block (diameter=5 cm). Soil cores spanned the bottom of the organic horizon to frozen ground. Immediately following collection, soil cores were separated in into 5 cm depth intervals. All equipment was wiped down with ethanol between plots to prevent isotopic contamination. Organic horizon samples were taken to the field lab where *A. latifolia* biomass was separated from organic soils within 48 hours and sorted by tissue type (attached litter, blades, sheaths, inflorescences, rhizomes, fine roots). Plant materials were then dried at 65°C for 24 hours. In the field lab, organic soil samples and soil cores were also subsampled for bulk density, gravimetric water content, and bulk soil %C and %N. All soil samples were then frozen and shipped to Oak Ridge National Laboratory, Oak Ridge, TN (ORNL) for further processing. (Note: This user guide includes only data for 15N labeled plots. Data from natural abundance plots can be found in supplemental files)

At two replicate locations within each chambered plot and co-located ambient plot, a trace amount of ^{15}N was introduced to the soil pool with a ^{15}N-NH_4Cl solution (2.4 mmol ^{15}N-NH_4Cl L^{-1}; Sigma Aldrich >= 98 atom% ^{15}N, Lot # MBBC2459). The solution was injected using a spinal port needle inserted to 3 cm depth. Each labeled area was 12 x 12 cm and injections were performed at 3 cm intervals in a gridded pattern. At each of the 16 injection points, a 5 ml aliquot of the ^{15}N-NH_4Cl solution was injected. Test injections of food coloring into the soil at this site revealed that the diffusion of this solution volume was approximately 1.5 cm- this

method therefore ensured we applied a consistent, even label of +200 mg ^{15}N m^{-2} (similar to loading in McKane *et al.*, 2002). To protect ^{15}N-labeled vegetation from herbivores, a wire mesh cage was installed around each injection area. After a period of six days, the inner 9 x 9 cm of each ^{15}N-labeled area was harvested following the protocol described above.

Attached litter, blades, sheaths, inflorescences, rhizomes, and fine roots tissues of *A. latifolia* were dried and weighed prior to being ground to a homogenous powder on a Geno/Grinder 2010 (SpexSamplePrep, Metuchen, New Jersey, USA) and analyzed for ^{15}N content on an Integra CN mass spectrometer (SerCon, Crewe, UK). Tissue-specific %C and %N were analyzed on a Costech ECS 4010 CHNSO analyzer (Costech Analytical Technologies, Inc Valencia, CA, USA). If fine root tissue samples were too small to run for ^{15}N, %N and %C, they were combined with fine root samples from adjacent depths. Any remaining gaps in chemistry data were filled with averages values from replicate harvests in the same plot (for %N and 15N) or from cross plot averages per tissue type (%C).

Tissue pools from each harvest (3 harvests per plot, 1 natural abundance harvest, 2 ^{15}N labelled harvests) were expressed per m^2 ground area based on the area harvested (9 cm x 9 cm). The atom percentage ^{15}N in excess (APE, atm%) for each tissue in ^{15}N labelled harvests was calculated as:

$$APE = {}^{15}N_{labeled} - {}^{15}N_{natural\ abundance}$$

where $^{15}N_{labeled}$ was atom percent ^{15}N for the tissue in the ^{15}N-labeled harvest and $^{15}N_{natural\ abundance}$ was atom percent ^{15}N of the tissue from the corresponding natural abundance harvest. ^{15}N uptake rate (µg ^{15}N m^{-2} hr^{-1}) during the entire incubation period was then calculated for each tissue as:

$$^{15}N\ uptake = Tissue\ N\ x\ \frac{APE}{100}\ x\ \frac{1}{T}$$

where Tissue N was µg N m^{-2} based on the tissue biomass and %N and T was the incubation time in hours. ^{15}N uptake reflects only the rate of uptake for the labeled form of NH_4 from the soil solution and is influenced by the dilution by the total available NH_4 pool in the soil. We therefore calculated overall N uptake (N uptake, µg N m^{-2} hr^{-1}) rate based on the isotope mixing model of (McKane *et al.*, 2002; Gallet-Budynek *et al.*, 2009):

$$N\ uptake = {}^{15}N\ uptake\ x\ \frac{C_{available\ N}}{C_{15N\ label}}$$

where $C_{available\ N}$ was the pool of water-extractable NH_4 in the diffusion zone where the ^{15}N label was introduced (1.5 cm to 4.5 cm depth based on 1.5 cm diffusion radius, mg N m^{-2}) and $C_{15N\ label}$ was the amount of ^{15}N introduced to the diffusion zone (200 mg ^{15}N m^{-2}).

References

Lewin KF, McMahon AM, Ely KS, Serbin SP, Rogers A. 2017. A zero-power warming chamber for investigating plant responses to rising temperature. Biogeosciences 14:4071–83.

McKane, R.B., Johnson, L.C., Shaver, G.R., Nadelhoffer, K.J., Rastetter, E.B., Fry, B., Giblin, A.E., Kielland, K., Kwiatkowski, B.L., Laundre, J.A. and Murray, G., 2002. Resource-based niches provide a basis for plant species diversity and dominance in arctic tundra. Nature, 415(6867), pp.68-71.

Gallet-Budynek, A., Brzostek, E., Rodgers, V.L., Talbot, J.M., Hyzy, S. and Finzi, A.C., 2009. Intact amino acid uptake by northern hardwood and conifer trees. *Oecologia*, *160*(1), pp.129-138.

Alistair Rogers, Kim Ely, Shawn Serbin. 2019. Vegetation Warming Experiment: Thaw Depth and dGPS locations, Barrow, Alaska, 2018. Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. Dataset accessed on 2021-05-25 at https://doi.org/10.5440/1523844

Vegetation Warming Experiment 2018 Related Datasets

Five chambers were deployed from June 17, 2018 to September 24, 2018 on the BEO within a 1 km2 area centered on 71.275N, -156.641W. Each chamber was co-located with an ambient plot on patches of tundra containing the target species *Arctagrostis latifolia*. The following 2018 datasets are complementary to the co-located 2018 15N Uptake Experiment datasets.

1. Shawn Serbin, Andrew McMahon, Alistair Rogers, Keith Lewin, Kim Ely. [PUBDATE]. **Vegetation Warming Experiment: Chamber and ambient plot digital camera imagery for vegetation phenology, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. [DOI].

2. Alistair Rogers, Kim Ely, Shawn Serbin. [PUBDATE]. **Vegetation Warming Experiment: Thaw Depth and dGPS locations, Barrow, Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. https://doi.org/10.5440/1523844

3. Shawn Serbin, Andrew McMahon, Alistair Rogers, Keith Lewin, Kim Ely. [PUBDATE]. **Vegetation Warming Experiment: Landscape-scale digital camera imagery for vegetation phenology, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem

Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. [DOI].

4. Alistair Rogers, Kim Ely. [PUBDATE]. **Vegetation Warming Experiment: Plant Physiology, Utqiagvik (Barrow), Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. [DOI].

5. Alistair Rogers, Kim Ely, Kenneth Davidson. [PUBDATE]. **Vegetation Warming Experiment: Leaf Mass Area, Leaf Carbon and Nitrogen Content, Barrow, Alaska, 2018.** Next Generation Ecosystem Experiments Arctic Data Collection, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tennessee, USA. [DOI].

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Data Access:

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